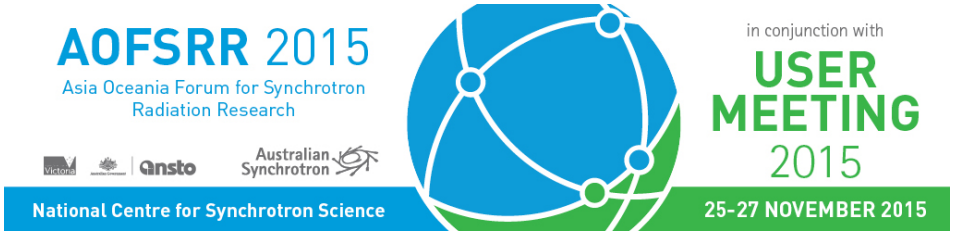

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The influence of Ni and Zn additions on microstructure and phase transformations in SnCu solder joints

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Microalloying, in which the solidification structure is preferably and significantly modified by trace elements, is a key method for improving Pb-free interconnections in electronic devices. Microalloying Ni or Zn is expected to modify the Sn–0.7Cu alloy in different ways. This research examines the influences of minor/trace additions of Ni and Zn concurrently on the development of the microstructure, the interfacial reactions and the stability of the intermetallics in Sn–0.7Cu solder alloys and associated joints, using X-ray radiography, X-ray florescence analysis, X-ray diffraction and electron microscopy. It shows that minor Zn additions (~0.15 wt.%) result in the formation of a CuZn intermetallic in the interdendritic region during solidification, whereas a small amount of Ni completely changes the solidification mode and a eutectic microstructure is obtained. When Ni is added, small particles of primary (Cu,Ni)6Sn5 intermetallic forms in advance of the solidification front. Microalloying Ni and Zn concurrently refines the microstructure and leads to a more continuous, finer-grained and stable interfacial Cu6Sn5 intermetallic and suppresses the growth of Cu3Sn. The Ni and Zn are homogeneously distributed in interfacial Cu6Sn5 and inhibit the polymorphic phase transformation of Cu6Sn5. This stabilizing effect minimizes the thermal expansion mismatch between interfacial Cu6Sn5 and the Cu substrate. The findings have important implications for the manufacture of high-reliability lead-free microjoints.

Keywords

Intermetallic compounds; X-ray synchrotron radiation; Phase transformations

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